composites

Multiple strengths, infinite possibilities

Reduce weight, boost design flexibility with composites

Fuel prices, while volatile, are likely to remain high for the foreseeable future. New Reformed CAFÉ Standards for light trucks are almost sure to be adopted by summer. And the pressure on auto makers to develop reliable alternative propulsion systems is steadily increasing.

As a result, many engineers are turning to reinforced thermoset composites, counting on a full range of structural and semistructural components to meet their design goals.

From the exotic Porsche Carrera carbon-fiber monocoque body to the dual-sunroof frame on the Cadillac SRX, to the more utilitarian grille opening reinforcement on the Ford F-150, composites are slashing vehicle weight, reducing tooling and manufacturing costs, and boosting durability.

Dropping weight

Many of you are specifically tasked with finding innovative ways to reduce vehicle weight; virtually every OE design engineer is encouraged to reduce part and assembly weight if the opportunity arises.

Reinforced composites offer you tremendous potential for accomplishing your weight reduction goals, not only through the use of exterior body panels, but also through application to cam and valve covers, fuel shields, oil pans and engine covers, grille opening reinforcements, even driveshafts.

Further advances in low-density and ultralow-density SMC are providing even more dramatic weight reductions — bringing reinforced thermoset composite parts into the same weight realm as aluminum specified at comparable structural strength. And composites generally cost significantly less.

7 compelling reasons to specify composites

Composites offer so many advantages, each application may have its own set. Compared to traditional materials, they offer:

Substantial weight reduction
FRP composites are typically 25-35% lighter than steel parts of equal strength.

Lowered manufacturing complexity
Fewer parts required for a finished assembly cuts manufacturing costs and often speeds run-up to design completion and model introduction.

Reduced tooling cost
Composite tooling cost is only 40% of steel stamping tooling cost.

Unparalleled damage resistance
Dent and ding resistance of composites is far superior to that of aluminum and steel panels.

Unrivaled corrosion resistance
Few materials offer better corrosion resistance than FRP composites in any application, automotive or otherwise.

Better internal damping
Leads directly to reduced noise, vibration and harshness (NVH).

Improved design flexibility
Molding offers shape complexity, geometry details, and a depth-of-draw range unavailable with metal stamping; in some cases, a part just can't be manufactured out of other materials.

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Improving appearance

Most exterior panels are semi-structural sheet-molded composites (SMC). Since they're appearance components, surface finish is a critical concern. Molders, resin and additive makers have been improving Class A appearance continuously through the development of toughened surface finish technology, high-performance UV sealers and low-profile additives.

SMC composite body panels offer unmatched impact resistance, nearly flawless surface quality, and they can be processed through the assembly plant paint line with first-run capability equal to steel's.

Torsional strength, rigidity, bending moment, energy absorption, temperature resistance, noise attenuation, and other engineering design parameters, on the other hand, can make or break your system.

And here you'll find one of the key benefits of composites — you can specify these parameters over a vast range, because the Tier 1 manufacturers can control them via proper selection of fiber and resin characteristics.

Fiber type, geometry, and mix proportion help determine strength-to-weight ratio and rigidity. Resin characteristics can be adjusted to provide the desired durability,

Building strength

In the early days of automotive composites, nearly every application involved exterior components (think 1954 Corvette). Today, many reinforced composite parts lurk underneath the visible body panels, inside the engine compartment… even within the driveline. Surface finish in these structural and semi-structural components isn't an issue — most are never seen after assembly.

manufacturing ease and speed, temperature tolerance and corrosion resistance.

Setting examples

When you consider applying composites to new parts, systems and platforms, it's reassuring to know just how broadly they've already been applied, and how much experience exists among the resin and fiber suppliers, as well as the molders

who make completed parts and assemblies.

Meridian Automotive Systems, ThyssenKrupp Budd and Molded Fiber Glass Companies, among them, have produced components for nearly every fathomable automotive application.

The 2005 model Toyota Tacoma pickup includes a composite box that became the star in some of Toyota's most memorable TV spots for the vehicle. The box is manufactured by ThyssenKrupp Budd from a fiberglass-reinforced polymer composite designed specifically to resist weather-related corrosion, plus the effects of vehicle fluids and cargo such as kerosene, garden chemicals, and pool salt.

Another pickup with a composite box, the Honda Ridgeline, boasts a unique underdeck, weathertight storage compartment that would be impractical to make from metal. In fact, the Ridgeline represents a new level of ease and convenience in the manufacture of vehicle storage. The composite box offers all of the traditional benefits of fiberglass-reinforced composites pickup boxes, plus the manufacturing efficiency of providing a storage compartment integrated into the box mold. The box is manufactured by Meridian Automotive.

In another functional application, the Cadillac SRX introduced dual, independently operating sunroofs — made possible by a unique full-roof-length frame fabricated from SMC by Molded Fiber Glass Companies.

Adhered to the surrounding structure with epoxy adhesive, the frame consolidates a substantial number of parts into one assembly, serves as the supporting structure for the sunroofs, and provides accommodation for the 83 brass inserts that serve as attachment points for the sunroof operating motors and window tracks, the rear window hinges, the sunshade and the wind dam.

Assuring the future

Composites are finding their way into many new applications. According to Richard Jeryan, a Technical Leader at Ford Motor Company, and a director of the Automotive Composites Consortium of USCAR, "Some are noticeable, and some are not."

"In the future," Jeryan said, "I expect to see some really cool exteriors made from composites. At the same time, internal storage applications will continue to grow, because they allow shapes you can mold only from composites."

Over time, Jeryan sees all automakers fundamentally altering the way cars are manufactured, but he expects it to be a slow process because of the current high investment in manufacturing equipment already in place.

Composites will continue to make inroads as cost of materials improve and composites manufacturers develop additional technologies and procedures, and perfect new assembly techniques for fastening and adhesive bonding.

"For structural applications," says Jeryan, "specifically in crash components, composites are very efficient energy absorbers. Many composite components serve an energy absorption function now, and as we develop better prediction models, we can expect their use to increase."

Creating alternatives

Since all of the alternative drivetrain vehicles (e.g., gas- or diesel-electric hybrids, electric vehicles, fuel cell vehicles) currently under development at USCAR and at individual vehicle OEMs are intended to reduce energy consumption, they're very sensitive to weight.

"All of these newer power trains tend to be heavier than current technology," notes Jeryan, "so we'll need to push weight reduction benefits as far as possible. And that means the extended use of composites." ■

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Reichhold's Dion® Hybrid Polyester resins are used extensively in underhood applications like valve covers and oil pans. Further, Dion® Urethane Hybrid and Vinyl Ester systems are excellent for pick-up boxes, seat backs, and other structural and impact-resistant applications.

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Bayer MaterialScience provides formulated polyurethane systems for high strength, lightweight, thermoset composites used in interior and exterior applications, including door panels, center consoles, instrument panel substrates, sunshades, spare tire covers, load floors, truck boxes and tailgates, bumper beams and structural supports. ■

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